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(54) Safety means for a printed circuit board

(57) In a printed circuit board, a safety means is provided to prevent the circuit elements (5) such as semi-conductor devices, resistors, and the like from suffering damage due to overcurrent flow. The safety means comprises a narrow gap (4) provided within a metal foil (2) pattern on the surface of the printed circuit board (1) and a low-melting point metal such as solder bridges this gap (4) to connect the metal foil (2).

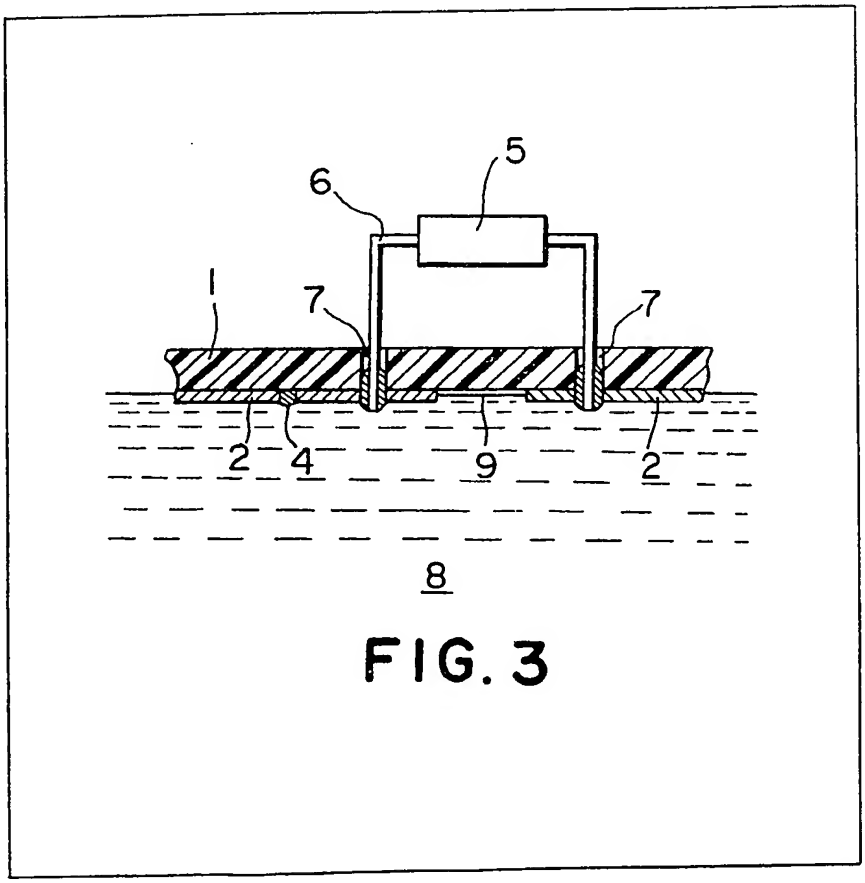

FIG. 3

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FIG. 1 (PRIOR ART)

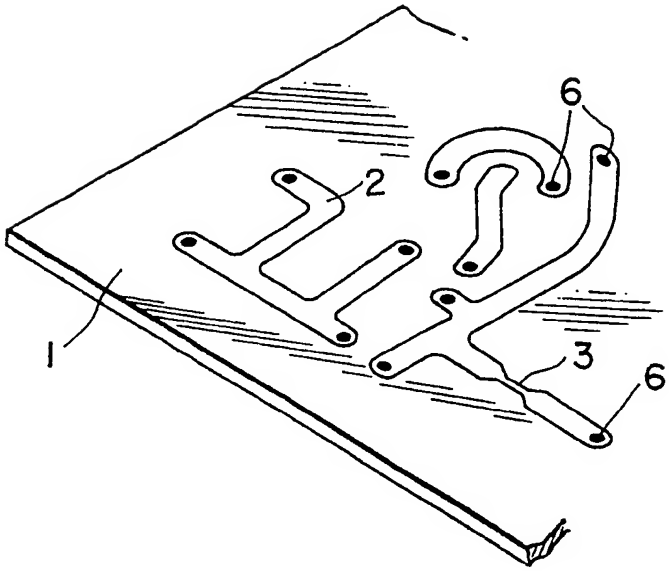


FIG. 2

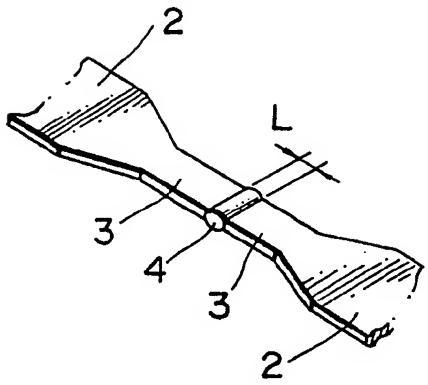


FIG. 3

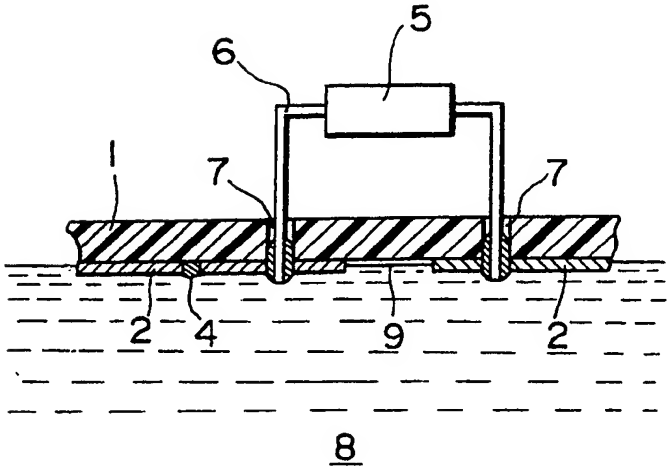
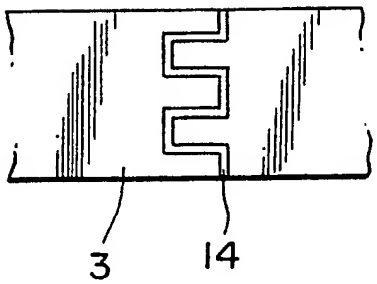


FIG. 4



SPECIFICATION

Safety means for a printed circuit board

The present invention relates generally to a safety means for a printed circuit board and, more specifically, to an overcurrent protector provided on the rear surface of a printed circuit board made up of a metal foil and low-melting point metal whereby the circuit elements and board suffers no damage due to overcurrent flow.

Conventional safety means arranged in a printed circuit board was a metal conductor itself in the form of aluminum or copper patterned on the rear surface of the printed circuit board.

In more detail, the conductor thus serving as a safety means has its width narrower than other portions of the conductor so that an overcurrent does not pass through the conductor because the conductor melts as soon as an abnormality occurs.

However, such conventional safety means for the printed circuit board has a shortcoming: since the safety means uses the same material as other conductors in the printed circuit board and has a narrow part, the narrow part in the conductor melts only when on overcurrent of higher than for example 50A flows therethrough. Therefore, in the case when a current somewhat higher than an ordinary current in the printed circuit board (for example, about 10A in excess of the allowable current of an ordinary safety means) flows therethrough, such conventional safety means does not function before the body of the printed circuit board is burned out because it takes a long time for the metal conductor of the safety means to arrive at the melting point (for copper 1083°C and for aluminum 670°C).

With the shortcoming described above in mind, it is an object of the present invention to provide a safety means for a printed circuit board such that a comparatively small current above a normal current flowing in the printed circuit board can be interrupted immediately without adversely affecting the circuit elements and the body of printed circuit board.

In the accompanying drawings:—

Fig. 1 is a partial perspective view of a voncentional printed circuit board of the prior art;

Fig. 2 is an enlarged view showing one embodiment of the present invention;

Fig. 3 shows an example soldering process for the printed circuit board according to the present invention; and

Fig. 4 is an enlarged view showing another embodiment of the present invention.

To facilitate an understanding of the present invention, a brief reference will be made to a conventional safety means for a printed circuit board. Referring to Fig. 1, numeral 1 denotes a board made of an insulating material such as resin. Numeral 2 denotes a metal foil patterned on the board 1. Numeral 3 denotes a narrow part whose width is made narrower than that of other metal foils so that its resistance is partially increased. Consequently, when a sudden large current flows into the narrow part 3 due to the occurence of an abnormality, the narrow part 3 of the metal foil 2 is melted to serve as the safety means.

However, such a safety means was uncertain for instantaneously interrupting a current somewhat larger than an ordinary current of about 1A or less using a simple reduction of cross section in the metal foil of the same material used.

Reference is now made to Figs. 2, 3, and 4, and more specifically to Fig. 2, wherein a preferred embodiment of the safety means according to the present invention is illustrated.

Fig. 2 illustrates enlargement of the narrow part 3 of the metal foil 2 shown in Fig. 1, wherein a narrow gap 4 is provided by a photo-etching process so as to intersect an elongated portion 3 of the metal foil 2. In the narrow gap 4 a solder is used to bridge the opposing metal foil 3. Since the thickness of the metal foil 3 such as copper, or aluminium, is usually in the range of 35 μm to 70μm, the metal foil 2 is cut off easily by the photoetching process, etc.

The width L below 0.3 mm is appropriate for the melted solder to fill the narrow gap 4 by capillary action. The solder will not flow into the narrow gap 4 if the width is above approximately 0.5 mm.

In Fig. 3 showing an example of the soldering process for the printed circuit board of the present invention, an aperture 7 formed by penetrating a portion of the board 1 and patterned metal foil 2 is provided to insert a lead 6 of a circuit element 5 from the front surface of the printed circuit board to the rear surface thereof. The rear surface of the printed circuit board is dipped in a reservoir of molten solder 8 in a conventional soldering process. At the same time as forming the connections between leads 6 and metal foils 2 by capillary action of the molten solder, the molten solder 8 of the reservoir premeates the narrow gap 4 and thus when the board 1 is removed from the reservoir, the solder solidifies to bridge the narrow gap in the metal foil 2. Since the gap 4 is of approximately the width described above, the solder forms a satisfactory bridge. On the other hand, the gap 9 is formed widely enough to prevent the solder from forming a bridge.

The following describes how the safety means according to the present invention works. In general, a normal current used on a printed circuit board is very small: much less than 1A. Since the narrow part of the metal foil and soldered gap will not generate heat under such a small current, the current flows therethrough normally. When an abnormality occurs and an overcurrent of, for example, 10A flows, the soldered gap 4 will not melt instantly, but when such a current flows for a period of time, the soldered gap 4 will heat up since the resistance of solder is large and its conductivity is lower than the metal foil made of material such as copper or aluminum. As the temperature of the solder in the gap rises, the solder begins to melt when the temperature arrives at approximately 200°C or the melting point of the solder. As the temperature rises

higher, the solder will splash to disconnect the gap in the metal foil 2. Therefore, such an abnormal current is interrupted without burning out the board 1 and circuit elements on the board 1, because they are not exposed to a high temperature.

When an abnormal larger current of, for example, 50A flows, the solder in the gap 4 is melted immediately to interrupt the current flow so that the circuit elements and board 1 can be safely protected. Since the solder, where the lead 6 of a circuit element 5 is connected to the corresponding metal foil 2, has a greater amount of solder used than that in the gap 4, it will not melt earlier than that in the gap 4.

Fig. 4 illustrates another embodiment of the present invention, where the gap 4 is of castellated shape 14 so that the melting current is adjusted to a desired value and the heat generated before melting is dissipated in every direction.

As described hereinbefore, according to the present invention the safety means is provided on the rear surface of the printed circuit board in such an arrangement that an intermediate part of the metal foil is provided with a narrow gap in which a low-melting point metal is used to bridge the gap so that the low-melting point metal is melted in an abnormal current ranging from currents of about 1A to higher currents without damage to the board and circuit elements mounted thereon, etc. In addition, in the soldering process of the printed circuit board, the soldering in the narrow gap can be made together with other soldering parts of the circuit elements to the corresponding metal foils, thus reducing the time required to complete soldering of the printed circuit board.

CLAIMS

1. A safety means for a printed circuit board, which comprises:

(a) a metal foil pattern on the printed circuit board having a narrow gap formed therein; and

(b) a low-melting point metal for filling the gap of said metal foil to bridge the gap of said metal foil,

whereby an overcurrent is interrupted by melting said low-melting point metal when an abnormality occurs.

2. A safety means for a printed circuit board as set forth in claim 1, wherein said low-melting point metal is a solder and the narrow gap of said opposing metal foil is in the form of a non-straight line whereby the current value at which said low-melting point metal melts immediately is adjusted to a desired value.

3. A safety means for a printed circuit board as set forth in claim 1 or 2, wherein said narrow gap of metal foil has a width narrower than any gap otherwise occurring between adjacent portions of the metal foil.

4. A safety means for a printed circuit board as set forth in claim 1, 2, or 3, wherein the narrow gap in said metal foil has a width not exceeding 0.5 mm.

5. A method of manufacturing a printed circuit board having an overcurrent safety means, which comprises the steps of:

(a) forming a metal foil pattern on the board including an overcurrent safety means section of the foil in which is formed a narrow gap; and

(b) dipping the printed circuit board in a reservoir of molten solder so as to form simultaneously a bridge across the gap and connections to components mounted on the board.

6. A safety means for a printed circuit board substantially as described with reference to, and as illustrated in, Figs. 2 and 3, or Fig. 4 of the accompanying drawings.

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